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Evaluation of Initial Graft Tension during ACL Reconstruction Using a Three-Dimensional Computational Finite Element Simulation: Effect of the Combination of a Band of Gracilis with the Former Graft

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Abstract : Background: The anterior cruciate ligament is one of the most frequent ligament to be disrupted. Surgical reconstruction of the anterior cruciate ligament is a common practice to treat the disability or chronic instability of the knee. Several factors associated with success or failure of the ACL reconstruction including preoperative laxity of the knee, selection of the graft material, surgical technique, graft tension, and postoperative rehabilitation. We aimed to examine the biomechanical properties of any graft type and initial graft tensioning during ACL reconstruction using 3-dimensional computational finite element simulation. Methods: In this paper, 3-dimensional model of the knee was constructed to investigate the effect of graft tensioning on the knee joint biomechanics. Four different grafts were compared: 1) Bone-patellar tendon-bone graft (BPTB) 2) Hamstring tendon 3) BPTB and a band of gracilis4) Hamstring and a band of gracilis. The initial graft tension was set as “0, 20, 40, or 60N”. The anterior loading was set to 134 N. Findings: The resulting stress pattern and deflection in any of these models were compared to that of the intact knee. The obtained results showed that the combination of a band of gracilis with the former graft (BPTB or Hamstring) increases the structural stiffness of the knee. Conclusion: Required pretension during surgery decreases significantly by adding a band of gracilis to the proper graft.

Keywords : ACL reconstruction, deflection, finite element simulation, stress pattern
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